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April 8, 2003

Popular Rotorcraft Association
NPRM / Regulatory Committee
c/o Greg Gremminger
17225 Pleasant Vw. Dr.
Ste. Genevieve, MO 63670

(573) 883-3541

Robert Wright, AFS-800, General Aviation and Commercial Division
800 Independence Ave. S. W.
Washington D.C. 20591

Subject: Request for modification to Exemption 5209H

Dear Mr. Wright,

The Popular Rotorcraft Association (PRA) is hereby formally requesting a change to the existing Exemption 5209H. This exemption allows training for-hire in Experimental Gyroplanes.

The current and recently renewed exemption continues to provide for training to Recreational and Private Gyroplane ratings only. The current exemption does not allow for training to Commercial and CFI Gyroplane ratings. The PRA continues to emphasize that the lack of provisions for training to the Commercial and CFI Gyroplane ratings is a significant contributor to the continued poor safety and fatality record of gyroplanes. The limited number of available Gyroplane instructors severely discourages proper and full training that would likely contribute to improved safety of gyroplanes. The limited availability of proper gyroplane instruction encourages both illegal (not rated) gyroplane operations and contributes to the resultant unacceptable gyroplane accident record. The disallowance of Commercial and CFI training under Exemption 5209H essentially requires the aspiring instructor to own their own 2-seat gyroplane to accomplish the required training and preparation for both Commercial and CFI ratings. The PRA maintains that this is not practical, as many persons are not able to make the financial expenditure for a training aircraft before pursuing the rating. This is a very significant impediment and discouragement to the much needed expansion of available Gyroplane CFIs and contributes significantly to the continued gyroplane accident record.

Additionally, "Transition Training" for gyroplane proficiency of pilots holding ratings in other aircraft types is not specifically allowed. Many rated pilots (rated in other powered aircraft types) desire to receive training in Gyroplanes in order to fly Experimental gyroplanes under the Part 61 allowance to fly Experimental aircraft with another powered aircraft rating. Since other requirements of Part 61 discourage or prevent achieving an "add-on" gyroplane rating, for many, this Experimental allowance in Part 61 is the only practical option to flying Gyroplanes legally. The result of not being able to provide this "Transition Training" under the provisions of Exemption 5209H strongly encourage flying gyroplanes without appropriate training and contributes severely to the continued unacceptable gyroplane accident and fatality record.

Additionally, numbers of persons require proper training in order to fly ultralight gyroplanes safely. Currently, ultralight training for-hire is allowed only with Basic Flight Instructors (BFI) under the Ultralight 2-Place Training exemptions. Since the number of Gyroplane BFIs is severely limited also, very few options for training are available for ultralight gyroplane pilots. The proposed expected Sport Pilot/Light Sport Aircraft (SP/LSA) rules will replace the BFIs with Sport Pilot Instructors, but readily available ultralight instruction is still important to reduce the number of accidents and fatalities in ultralight gyroplanes. The current 5209H Exemption does not currently allow training for-hire for ultralight pilots.

Legal training for-hire for ultralight gyroplane pilots must be readily available in order to effectively encourage training.

Additionally, the proposed and expected SP/LSA rules will likely not allow or provide allowed training gyroplanes for Sport Pilot Instructors to provide training. Even if the FAA would allow LSA gyroplanes (available for Sport Pilot Instructors), it is unlikely that gyroplane manufacturers, for liability reasons, would elect to produce and sell factory-built LSA gyroplanes in the foreseeable future. This would severely reduce the available gyroplane instruction. It is imperative that 5209H allow training for-hire by both CFIs and Sport Pilot Instructors for the Sport Pilot rating with gyroplane endorsement in Experimental gyroplanes. Otherwise, without legal availability of training, deficient or insufficient training, especially in ultralight gyroplanes and illegal "heavy" ultralight gyroplanes, will continue to be the unsafe option for many.

Attached is a previous letter submitted to the FAA (Mr. John Wensel) outlining a number of rules and provisions and impediments that discourage adequate and proper training in Gyroplanes. This letter provides further details on the issues presented above. I have highlighted those specific sections in the attached letter (copy). We are still hopeful the FAA will soon address all the issues presented in this letter to Mr. Wensel. We would prefer these recommendations and the requested Exemption changes be implemented expeditiously so as to begin to reduce accidents and fatalities as soon as possible. By historic trends, each 6 month delay in these actions might result in an additional 3-6 fatalities in gyroplanes in the U.S..

Also attached is a report, requested last year by the FAA, investigating the major contributing causes to the continuing poor accident statistics for gyroplanes. This report indicates that a major contributor to the accident statistics is the minimal availability of proper gyroplane training. The report emphasizes that the impediments and discouragements to expanding the Gyroplane CFI base must be eliminated in order to grow the availability of gyroplane instruction.

Specifically, the PRA is requesting urgent consideration of the following changes to Exemption 5209H:

Section 2:

Change From:

The flight instructor who conducts the flight training, must --

- a. Hold an FAA flight instructor certificate with a rotorcraft-gyroplane rating; and
- b. Have a total of 250 hours of flight experience, of which 100 hours were in gyroplanes and 10 hours were in the specific make and model of gyroplane in which he or she is giving instruction.

Change To:

The flight instructor who conducts the flight training, must --

- a. Hold an FAA flight instructor certificate with a rotorcraft-gyroplane rating; and
- b. For a CFI rating, have a total of 250 hours of flight experience, of which 100 hours were in gyroplanes and 10 hours were in the specific make and model of gyroplane in which he or she is giving instruction.
- c. For a Sport Pilot with Instructor rating, meet the experience requirements of the Sport Pilot rules.

ATTACHMENT 1 (COPY)

December 19, 2001

Popular Rotorcraft Association
NPRM / Regulatory Committee
c/o Greg Gremminger
17225 Pleasant Vw. Dr.
Ste. Genevieve Mo. 63670

John Wensel, AFS-800, Airman's Certification
800 Independence Ave. S. W.
Washington D.C. 20591

Dear Mr. Wensel,

In mid-August, I had a phone conversation with you and Mr. Bob O'Haver concerning Parts 61 and 91 regulatory issues affecting Gyroplane training, certification and safety issues. At that time, I informed you that the Popular Rotorcraft Association (PRA) had commissioned a group of prominent Gyroplane instructors to address and work with the FAA on these issues. At that time, you suggested that we prepare a letter from our committee to you outlining the issues we feel need attention in forthcoming proposed rule changes to Parts 61 and 91.

Our PRA NPRM / Regulatory committee consists of the following three members:

Lisa deVries:	Airplane/Gyroplane CFI
Ron Menzie:	Gyroplane CFI/Designated Examiner
Greg Gremminger:	Gyroplane CFI

As you may be aware, Gyroplane training and certification is currently available only in Experimental certificated aircraft. The unfortunate passing of Don Farrington in April 2000 has evaporated the only training facility with certified gyroplanes in this country. A recent survey of gyroplane instructors did not show any instructor-owned Air & Space in flyable condition available for training. This has put gyroplane training in a very different position from training in other category-and-class aircraft. There are currently two available exemptions that allow training-for-hire in Experimental Gyroplanes:

1. Exemption 5209G, issued to the PRA allowing Experimental gyroplane training for Recreational and Private ratings, biennial flight review, and for "maintaining or improving pilot skills and proficiency."
2. Exemption 7162A, issued to the Experimental Aircraft Association (EAA) allowing aircraft-specific TRANSITION training in an Experimental aircraft - not training to a rating.

Note that these two exemptions together cover the following training areas:

- Recreational or Private Pilot Gyroplane certification training
- Flight reviews
- Maintenance or improvement of pilot skills and proficiency
- Aircraft-specific transition training (presumably, this would allow training for an airplane-rated pilot, for instance, to transition train to fly an experimental gyroplane under the allowance that that airplane-rated pilot may fly an Experimental aircraft on his/her airplane rating)

Please note that there are several (confusions or ambiguities in the) limitations of these two exemptions. Specifically, these two exemptions do not clearly provide for or allow training-for-hire in several important instances:

- Training toward Gyroplane Commercial or CFI ratings
- Transition training for Helicopter or Airplane rated pilots into Experimental Gyroplanes
- Introductory training or "demo rides" for prospective Gyroplane pilot trainees

These are just a few of the issues that could be resolved in forthcoming changes to Parts 61 and 91. This committee has prepared and offers to you the following outline of gyroplane-related issues and suggestions:

PRIVATE GYROPLANE RATING:

The ability of gyroplane CFIs to recommend applicants for the Private Gyroplane rating is severely limited by the current requirement for night cross-country training. Very few prospective gyroplane pilots are inclined to fly at night and few if any instructors will provide such training in experimental gyroplanes because of the (risks and) difficulties involved:

- Lack of instruments and attitude references in available experimental training gyroplanes
- Open cockpit environment
- The "black hole" effect in most rural areas where experimental gyroplanes are confined to fly
- Experimental or non-certified engines on most experimental training gyroplanes

If night cross-country dual training is to be performed, most instructors will prefer to pick very optimum conditions such as a cloudless sky, full moon, good visibility, hospitable and open terrain, warm weather to allow higher altitudes, lights on the ground, and a large dewpoint spread. The limited occurrence of these conditions alone severely limits the opportunities for instructors and students to accomplish this requirement. This requirement, its risks and scarce opportunity to accomplish, in itself is conducive to endorsement falsifications and shortcuts. And then, the pilot, upon gaining the private rating, is authorized to fly at night under much worse conditions for which he/she realistically has not been trained.

RECOMMENDATION:

- Allow the choice or restriction:
 - VFR (no restrictions) for Gyroplane Private rating - requires night cross-country dual
 - DVFR (day only restriction) for Gyroplane Private rating
 - require only 1 to 3 hours of night flying (local familiarization at night)
 - require 10 TOs and Landings separated with traffic pattern

RECREATIONAL GYROPLANE RATING:

Inconsistencies with Part 61 wording make it impractical in most cases to gain the appropriate requirements for the Gyroplane Recreational rating:

- 61.99 (a)(2): Requires training in "the aircraft for which the rating is sought":
- Does this require training in the SPECIFIC aircraft?
 - What about single-seat aircraft?
 - Should this mean or say "in category/class aircraft" (consistent with Private rating wording), allowing training in a representative dual control training aircraft, not necessarily the applicant's specific aircraft?
- 61.101 (b)(3): Requires applicant to be "found proficient in THE AIRCRAFT at THE DEPARTURE AIRPORT and the area within 50 NM from that airport":
 - Does this require training in the SPECIFIC aircraft?
 - What about single-seat aircraft?
 - Training for the 50 NM area would require accompaniment by the instructor!?
 - Should this mean or say "in category/class aircraft" (consistent with Private rating wording), allowing training in a representative dual control training aircraft, not necessarily the applicant's specific aircraft
 - Clarify - Could this training be accomplished in another category/class aircraft by another category/class CFI? (i.e.: in an airplane at the departure airport?)
- 61.101 (b)(2 and 3): Requires ground and FLIGHT training at, or in the vicinity of, "the departure airport":
 - What about single-seat aircraft?
 - Gyroplane instructors are not available at most airports – see note
 - Clarify - Could this training be accomplished in another category/class aircraft by another category/class CFI? (i.e.: in an airplane at the departure airport?)

NOTE: (Gyroplane instructors are sparsely available around the country, requiring the additional expense and logistics of the gyroplane CFI traveling to the student's airport – with a dual seat trainer. More often than not, the student is seeking the privileges to fly their own single-seat experimental gyroplane in which dual training is not an option.)

The Recreational rating really has little gyroplane functionality if training is required at "the departure airport" in the specific aircraft.

RECOMMENDATION:

- Eliminate the night cross-country training requirement and allow the DVFR only restriction on the Gyroplane Private rating (recommended above). This would eliminate most need for the Gyroplane Recreational rating.
- If it is desired to make the Recreational Gyroplane rating a practical rating:
 - Allow training in a similar or representative trainer aircraft - rather than in the specific aircraft.
 - Allow "departure airport" training or familiarization to be accomplished and logged by non-gyro CFIs in any aircraft or allow ground training familiarization for that airport.

COMMERCIAL / CFI GYROPLANE RATING:

With the coming advent of commercial gyroplanes (ie: Groen Bros, Hawke 4 and CarterCopter), availability of affordable training to the Commercial rating will be even more important. Future expected applications such as carrying passengers or crop dusting will make training to Commercial and CFI levels in affordable experimental gyroplane trainers even more essential in the near future.

Currently, 5 hours of instrument training in "an aircraft" are required for the gyroplane Commercial rating. Gyroplanes are not equipped for instrument flight and instrument training in a gyroplane is simply not available. An instrument rating for gyroplane does not even exist. This is another area that makes gyroplanes unique in the aviation community. (To IFR equip experimental gyroplanes is both prohibitively expensive and difficult to do because of limited instrument panel space). Even the upcoming Groen Bros. Hawke 4 is not proposed to be instrument equipped. To meet this instrument training requirement in AN AIRCRAFT, a gyroplane Commercial candidate must also receive appropriate training in another category or class aircraft to a proficiency adequate to receive instrument training in that aircraft. Indeed, instrument training in another aircraft type arguably does not even apply because gyroplanes have much different control characteristics than either airplanes or helicopters. (Since IFR equipped gyroplanes are not even available, it makes little sense to discourage Commercial / CFI ratings by the added expense of unproductive time to meet this non-essential requirement). Instrument equipped gyroplane simulators do not exist.

Currently, there are no avenues to receive Commercial or CFI training in the available experimental gyroplanes. The PRA exemption 5209G does not allow training-for-hire above the Private rating. There are fewer than 25 active gyroplane CFIs who own a two-seater gyro in the U.S. as most of the 180 Gyroplane CFI's do not own their own two-seater gyroplane. The only way, currently, to receive the required training and endorsements is for the CFI Gyro candidate to own his/her own gyroplane in which to receive that training. This very expensive proposition does not encourage new gyroplane CFIs. A major impediment to the availability of good gyroplane training and to encouraging gyroplane enthusiasts to acquire ratings is that gyroplane instructors are few and far between. Often CFIs must or should provide training in the aircraft the student either owns or will be flying - not necessarily in the aircraft the instructor owns. In other cases, multiple CFIs may be sharing or utilizing an available club or local trainer and has no need or resources to own their own gyroplane trainer.

The FAA typically does not require ownership of an aircraft to acquire a higher rating. It is much more important to the safety of gyroplane operations that good CFI training (and thereby gyroplane training itself) be much more readily available. In other words, we feel it is essential to improved training availability and safety to be able to train to the Commercial / CFI ratings without the requirement to own a

trainer aircraft. The current necessity to own an aircraft in order to achieve a CFI rating discourages applicants - resulting in less training availability in the future.

RECOMMENDATION:

- Allow training in experimental gyroplanes for all ratings up to Commercial / CFI.
- Eliminate the requirement for Instrument training for Commercial / CFI rating.

ADD-ON GYROPLANE RATING:

The add-on rating option can be a valuable and quick way to improve the number and proficiency of rated gyroplane pilots and especially to improve the availability of gyroplane instructors. However, the impediments to both Private and Commercial / CFI ratings above prevent or discourage gyroplane add-on ratings in these categories. Especially for add-on ratings to gyroplane Commercial / CFI ratings, it should not be a requirement that the applicant own their own training gyroplane. Cross-country time, including night cross-country time acquired in another category/class aircraft should apply to the add-on gyroplane rating.

Note that we do recommend that the requirement for gyroplane operation at a controlled airport should still be a requirement because gyroplane arrival, landing, taxi and departure operations may differ considerably from other category aircraft.

RECOMMENDATION:

- Same as for Private gyroplane rating above
- Same as for Commercial / CFI gyroplane rating above

TRANSITION TRAINING INTO EXPERIMENTAL GYROPLANES:

Current and foreseeable rules pertaining to experimental aircraft allow pilots holding any category/class pilot rating to fly any experimental aircraft. With the difficulties outlined above in obtaining gyroplane ratings, this special experimental rating allowance has been a major avenue for pilots to legally fly experimental gyroplanes. However, transition training-for-hire into experimental gyroplanes is not covered under the PRA 5209G Exemption. The EAA 7162A exemption arguably allows for this "transition" training, but requires the CFI to hold and administer both exemptions to conduct a range of proper training. This is another unnecessary impediment to good training options and is another encouragement to many to "self-train" because the "legal" way is just too confused. In fact, "transition training" is not a requirement to utilize the experimental aircraft allowance, presenting further discouragement to receiving the much recommended "transition training" in make and model of gyroplane. Because there are so many varied models and operating characteristics of gyroplanes, "transition training" is of even more importance and should not be compromised by impediments or discouragement to seek proper training.

RECOMMENDATION:

- Allow training-for-hire in experimental gyroplanes for all training and skills and proficiency enhancement training, including "transition training" into aircraft specific gyroplanes.
- Require logbook endorsement by specific make and model to allow use of the experimental aircraft rating allowance.
- Highly recommended: Change regulations to allow training for ratings, for transition, and for proficiency, to be allowed for-hire in experimental aircraft.

TRAINING IN EXPERIMENTAL GYROPLANES

Currently, and for the foreseeable future, the only available trainer gyroplanes are experimental aircraft. The Sport Pilot / Sport Plane (SPSP) NPRM will apply only to those trainer aircraft that meet the Sport

Plane requirements - a number of currently popular trainer gyroplanes probably will not meet those requirements. There will always be a need for gyroplane training beyond SPSP, such as for Commercial / CFI ratings. The current exemptions leave too many gaps toward a healthy expansion of gyroplane training options. Without full coverage of affordable and readily available training options, gyroplane enthusiasts often elect to "self-train" and fly illegally - which leads to increased accidents and worse.

It is essential that prospective gyroplane owners and pilots be introduced into a standard training program from their initial introduction to gyroplanes. Otherwise, their priorities often are to purchase or build a gyroplane first, with considerations of training being a secondary and non-essential consideration. Therefore, it is essential that gyroplane proponents have a means to introduce prospective pilots and buyers to the training process at the very beginning of their exposure to gyroplanes. This is typically and normally accomplished via introductory training sessions or "demo rides." The experimental exemptions arguably allow introductory training lessons or "demo rides." It is, however, just as arguable that intro training rides are not allowed under these exemptions. Because this is an essential introduction to flight and gyroplanes that will encourage or discourage proper attention to safety, training, etc., we feel it is essential that "introductory training lessons" into gyroplane operations be a clearly allowed and provided for activity under the exemptions or under the experimental aircraft rules themselves. It is certainly true that these very first introductory training lessons provide the most training experience for the minimal flight time, and that this time sets the standard for all future training for that prospective pilot. Inability to provide "introductory training rides" encourages self-training and discourages access and exposure to important gyroplane and flight information and issues.

RECOMMENDATION:

- Clearly define the stages of training, including "introductory training lesson" in the exemptions or regulations themselves.
- Clearly allow for "introductory training lessons" or "demo rides" in the exemptions or regulations themselves.
- Highly recommended: Change regulations to allow training for ratings, for transition, and for proficiency to be done in experimental aircraft.

EXPERIMENTAL AIRCRAFT PHASE I FLIGHT REQUIREMENTS:

Interpretations of who can fly the Phase I flight hours on an Experimental category aircraft vary by FSDO or DAR. Wording in the EAA Exemption 7162A seems to imply that this exemption allows transition training in the Phase I Experimental aircraft for the purpose that the builder may be trained to fly off the required test flight hours - but that interpretation is arguable as well. It is not a reasonable option for an experimental aircraft builder to hire someone to fly off the full 40 hours of Phase I test flight hours - before that builder may receive training in his/her aircraft or fly it solo. This is especially true since an advantage to the experimental aircraft builder is that a rating for that specific type aircraft is not required to fly the experimental aircraft. A requirement for a gyroplane rated pilot to fly the full Phase I flight hours certainly encourages a "twisting of the rules" and discourages proper training and safety.

RECOMMENDATION:

- Clarify rules to require and allow that some initial Phase I flight test hours be flown by a gyroplane "experienced" pilot - gyroplane rated, or gyroplane experienced and flying on another category / class rating under Experimental rules.
- Clarify rules to allow training or familiarization of the builder by a CFI within the Phase I hours in that aircraft.
- Clarify rules to allow the builder to fly the remaining solo Phase I flight hours on a logbook solo endorsement from a gyroplane CFI.

CATEGORY / CLASS RATING REQUIREMENT TO FLY EXPERIMENTAL AIRCRAFT:

Interpretations of what ratings are required to fly an Experimental category aircraft vary by FSDO and DAR. The terminology in 8130.2D, Par (18) invites varying interpretations in the Operating Limitations

for experimental aircraft. It is often mis-interpreted as to whether the Operating Limitations in an experimental aircraft must require the pilot to have "THE APPROPRIATE category / class rating" or "A category / class rating" - meaning ANY category / class rating to fly an experimental gyroplane. We understand and endorse the FAA proposed rule change that would allow a pilot holding any category / class rating to fly an experimental gyroplane solo, but that a gyroplane rating would be required to carry a passenger in an experimental gyroplane. However, BEFORE making this change, the above impediments to achieving either a Private or Recreational gyroplane rating must be corrected. Otherwise, removing the ability to carry passengers in an experimental gyroplane on any type rating will simply encourage more illegal operation because it is currently so difficult to actually get a gyroplane rating.

RECOMMENDATION:

- Clarify the 8130.2D, Par (18) terminology to eliminate confusion as to what requirements should be made on an experimental aircraft's Operating Limitations. This should clearly define that ANY category / class rating is adequate to fly an experimental aircraft solo (i.e.: an experimental gyroplane may be flown solo by pilot holding an airplane or helicopter rating).
- Change the rules to clearly define and require the appropriate rating to carry passengers in an experimental aircraft (i.e.: carrying passengers in an experimental gyroplane requires a gyroplane rating).

NOTE: The above impediments to gyroplane ratings (Private or Recreational) must be changed to make getting a rating practical. The above impediments must be corrected BEFORE restricting carrying passengers in experimental gyroplanes to gyroplane rated pilots only! Otherwise there is no legal avenue to comply.

In summary, our committee concurs with the NPRM concept to define training activities in an Experimental category aircraft separately from the restriction of "carrying passengers for hire" in experimental aircraft. This change should allow all forms of training addressed above. Training of all sorts, as discussed above, is vitally necessary to safety and should not be impeded by restrictions or interpretations as outlined above.

Our committee also agrees with a change in the rules that would require the "appropriate category/class rating" to carry a passenger in an experimental aircraft. We would concur that ANY category/class rating should still be adequate to fly solo in an experimental aircraft. However, a change to require "the appropriate" rating to carry passengers in an experimental aircraft MUST BE PRECEDED by removal of the above impediments to meeting the requirements for those ratings.

The committee sincerely hopes these comments and recommendations will be helpful to you in formalizing the Part 61 / 91 NPRMs that you will be proposing. We are available for consultation on these issues at any time.

Sincerely, Greg Gremminger (573-883-3541, email: gyrogreg@ldd.net)

CC: Bob O'Haver, AFS-820, Aircraft Certification
Sue Gardner, AFS-802, Sport Pilot NPRM Program Manager
Lisa deVries - PRA NPRM / Regulatory committee
Ron Menzie - PRA NPRM / Regulatory committee

References:

Far Part 61 and 91
PRA exemption 5209G
EAA exemption 7162A
Operations Limitations
Handbook 8130.2D

ATTACHMENT 2 (COPY)

REPORT to the FAA Gyroplane Accident Causes

Submitted by: Greg Gremminger, ASTM Gyroplane LSA Subcommittee Chairman
Requested by: Sue Gardner, FAA Sport Pilot Project Manager

This report was requested by Ms. Sue Gardner, FAA Sport Pilot/ Light Sport Aircraft Project Manager, as a result of recent continued fatal accidents in experimental sport gyroplanes. This report is an effort to identify root causes of the continuing poor gyroplane accident record in order to identify actions that might be appropriate within industry and/or by the FAA to reduce the fatal accident rate.

The NTSB data analysis (Addendum 1) identifies two major contributing causes or issues related to the continued accidents in gyroplanes:

- Pitch stability related issues
- Proficiency or training related issues

This report consists of three parts included as addenda in this report:

1. Statistical analysis of past three years of NTSB gyroplane accident reports - identifies major contributing issues
2. Synopses of gyroplane aerodynamics and other issues related to pitch stability accident causes
3. Training and instruction issues related to proficiency accident causes

The NTSB statistical analysis was prepared by Mr. Kevin Molloy. Please note in the analysis report (Addendum 1) there are several deficiencies possibly inherent in depending on the NTSB reports:

- The NTSB reports cover only the "N" numbered experimental aircraft. Gyroplanes that are claimed to be ultralight or otherwise not registered are not included in NTSB accident reports. There are perhaps triple the number of actual accidents and fatalities than those identified by NTSB reports. Accident data and statistics are not reliably available for the non "N" numbered gyroplane accidents. The NTSB reports do, however, reflect a general cross-section of the typical issues involved in all gyroplane fatal accidents.
- NTSB reports are most often inconclusive or misleading as to the true root causes of gyroplane accidents. Due to unfamiliarity by the investigator with gyroplanes and gyroplane accidents, the reports often times must be read-between-the-lines to identify the true root causes. Determination of root causes from NTSB reports is therefore sometimes a subject of debate. This analysis attempts to assign root causes according to informed interpretations of the NTSB reports and attempts to include alternate or contributing "shared" root causes.
- Because the NTSB reports cover only "N" numbered gyroplanes, two-place gyroplane models may receive mis-proportional coverage in the NTSB system. It is possible that other, non-registered single-place gyroplanes may indeed have worse accident and fatality records than those which appear often in the NTSB reports. It is felt, however, that the NTSB data accurately reflects the issues involved in the majority of gyroplane accidents and fatalities.
- An analysis of the NTSB data necessarily includes only accidents that have occurred in the United States. This analysis does not include the numerous accidents that have occurred in other countries. However, the database presented by the NTSB reports is also felt to appropriately depict the major accident issues.

Gyroplane aerodynamics, especially as related to pitch stability, is a new and oftentimes still debated technology. The past ten years have yielded substantial advancements in the understanding of aerodynamic pitch stability in gyroplanes as relates to the common unrecoverable pitch stability related accidents. Unfortunately, heated debate and passion over the instability issues and in response to the continued high fatality rates have created an atmosphere where consensus on the true issues is probably unattainable. Historically, the original Bensen Gyrocopter was of questionable stability. The original Bensen Gyrocopter did not incorporate adequate pitch dampening - it did not use a horizontal stabilizer. This early model established a reputation of high accident rates due to self-training in a neutrally stable aircraft. Evolutions from this early Bensen gyrocopter often aggravated the pitch stability issues with incorporation of higher thrust, larger propellers, raised propeller thrustlines, body enclosures and windcreens, faster airspeeds, and lower mounted and draggier components - many without appropriate aerodynamic accommodations. As a result, the accident rates have skyrocketed on certain evolutions.

Aggravating this safety situation were the demonstrations and claims by older experienced pilots, and by vested manufacturers, that aerodynamic stability in gyroplanes was unachievable, or unnecessary - as demonstrated by a proficient pilot. There are still many gyroplane proponents that discourage the use of pitch dampening components or configurations as unnecessary or even dangerous. Many gyroplane proponents passionately debate the validity of the maturing gyroplane stability technology. The debate oftentimes centers on the use or non-use of horizontal stabilizers on gyroplanes. True gyroplane aerodynamics is often misunderstood or reduced to debatable or misleading rules-of-thumb. The current state of polarized and passionate defensive and accusative arguing is further

confusing these issues because many in the community don't know what to believe - they hear passionate and apparently plausible arguments from all sides. Addendum 2 of this report is an attempt to describe and clarify the technical issues related to gyroplane pitch stability related accidents.

Addendum 3 address proficiency or training issues that are contributing to gyroplane continued accidents. The gyroplane training situation is much different from that of the traditional aircraft types. Instructor availability is spread so thinly across the U.S. that normal completion of pilot training or transition is difficult. The result is that enthused students often may not complete the necessary training or experience to be safe pilots. Because of the wide variation in experimental gyroplane flight characteristics (varied pitch stability and handling characteristics), it is an often unrecognized requirement to receive training and build experience in specific gyroplanes or gyroplane configurations - not many gyroplanes fly alike, especially those that do not incorporate adequate aerodynamic stability measures. Finding the appropriate training for a specific gyroplane further aggravates the availability of appropriate and safe training.

In conclusion, the NTSB accident data concur with known situations in both gyroplane stability design and training infrastructure deficiencies to indicate where resources and actions might best be focused to improve the current fatality record. The training situation is fundamental, and all efforts must be made to grow, rather than reduce the availability of instructors and flight check Inspectors and Designated Examiners. Additionally, attention should be refocused on training beyond gyroplane fundamentals for both new pilots and transition pilots. Instructors should renew and strengthen training in Aviation Decision Making (ADM) - including good judgement decision making based on valid gyroplane aerodynamics and understanding of safe flight envelopes in various gyroplane configuration types. I recommend that the FAA conduct a correlation study between the accident record and the instructor(s) of those pilots to see if those individual gyroplane instructors might provide some insight or training improvements to avoid repeated accidents from judgement or proficiency causes. See Addendum 3 for specific recommendations on these issues.

Ideally, gyroplanes should all exhibit safe and similar flight and stability characteristics. Given the nature of Experimental aircraft and the deep divisions within the gyroplane community on stability and safety issues, it may not be possible - within the gyroplane community - to effect such consistency. The effort within the proposed Sport Pilot / Light Sport Aircraft (SP/LSA) rules to develop industry consensus standards may be our best hope. But, the divisions and passions within the gyroplane community at this time are not conducive to developing an objective consensus standard. I hope that the FAA will take a leadership role in facilitating and guiding the gyroplane consensus standard subcommittee toward the development of a constructive standard, especially of a standard that appropriately addresses the dynamic stability issues. Although the SP/LSA consensus standard would apply to very few models or manufacturers - if any - the existence of an accepted standard would strongly promote application of good stability technology and the acceptance of appropriate gyroplane stability and handling principles. See Addendum 2 for specific recommendations on these issues.

Gyroplanes, with their simplicity, immunity to stall/spin, high maneuverability, large controllable speed range, extreme structural integrity, short and slow landings and capacity to handle high and turbulent winds easily, have the potential to be the safest type of light sport aircraft available. The stability and training issues identified and presented in this report continue to derail the realization of this safety potential. Several gyroplane configurations and models have demonstrated their true safety potential. Gyroplanes have evolved into attractive, reliable, high performance and viable sport aircraft. I sincerely hope that this report serves to constructively address these troubling safety issues and eliminate the resulting fatalities that have continued to frustrate the true safety potential of gyroplanes. But, above all else, the fatalities that continue at such a discouraging rate must be eliminated.

Sincerely,

Greg Gremminger, ASTM Gyroplane LSA Consensus Standard Subcommittee Chairman

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ADDENDUM I**GYROPLANE CRASHES by CAUSE(S)**

January 1999 – August 2002

B. Kevin Molloy, M.S.E.H., R.E.S.

Background

National Transportation Safety Board reports were retrieved from the Internet website and reviewed for the period of January 1999 until August 2002. Analyses as to cause of each crash were conducted based on the narrative of the reports and the NTSB findings. The majority of the reports were the final version, with the exception of the 2002 reports, which were mostly the preliminary reports. When the full narrative of the reports were available, they were reviewed for additional information.

Data from the reports were summarized in a database. The reports were reviewed for cause(s) of the crash, aircraft make, severity of injury, case number and whether or not the gyroplane had a horizontal stabilizer. Sections for comments and contributing factors were also included. It should be noted that assigning and prorating root causes required some subjective decisions to group causes. These decisions were based on analyses of the narrative descriptions, and the development of cause groupings that repeated. Decisions were also based upon the author's knowledge of gyroplane flight characteristics and knowledge and experience in aviation and aviation crash reviews as well as his public health experience in injury analyses.

The author has over 22 years experience as a federal public health officer. He holds a bachelor's degree with a minor in Aerospace and a Master of Science degree in Environmental Health, which included studies in statistical analyses and investigation methods. He also completed a fellowship in injury prevention with a federal agency. He has been a member of the Civil Air Patrol Search and Rescue operations for missing aircraft for over 10 years and has built and flown gyroplanes as well as having flown fixed wing aircraft. In 1990, a similar study of gyroplane crashes was completed by the author for the period of 1978 - 1987. Future plans are to report on data from 1987 to date.

Description of Data (See Attachment A)

A total of 44 sport gyroplane crashes were reported in the NTSB files for the period of January 1999 to August 2002. This sort was of all makes and models of sport gyroplanes for the time period. Causes were placed in the following categories based upon the descriptions in the reports:

Deficient Proficiency: Pilot's experience in gyroplanes and in that gyroplane - including deficiencies in training and judgement. Proficiency is considered as a "shared", if not primary contributing cause in most accidents. Proficiency is often the primary cause in takeoff and landing incidents. All causes are prorated in this analysis as to percentage level of contribution to the accident.

Pitch Stability: The aircraft went into an unstable mode. This includes incidents indicated by rapid pitch oscillations or maneuver, tumble, in-flight rotor strikes on other aircraft components, in-flight loss of rotor RPM, and high speed or turbulent wind excited loss of control. Pitch Stability is often a "shared" cause with Deficient Proficiency, since getting into this situation often involves the pilot's training or judgement in these areas.

Power Failure: Loss of power due to engine problems.

Hit Object: The gyroplane impacted a ground object (wire, fence, tree, etc.) while maneuvering. This cause is often prorated proportionally with other cause factors when other factors also precipitated the crash (e.g. engine failure, loss of control). Terrain impact is not included in this cause when the terrain impact was inevitable from other causes.

Mechanical Failure: Failure of some component of the aircraft other than the engine.

Wind: This included abrupt cross winds and gusts, effects of tailwinds and down wind turns on low-level or landing/takeoff incidents - not related to pitch stability of the aircraft. Often a "Wind" cause is shared with the "Deficient Proficiency" cause.

Other: Cause did not fit into a category or information was unavailable. In one "crash" the aircraft was not found and in several only the preliminary report was available and there were few details. In some cases, there were no witnesses and no indication of the cause by examination of the wreckage. Often a "Other" cause is shared with the "Deficient Proficiency" cause. "Other" causes may include unexplained loss of control, inadequate preflight issues,

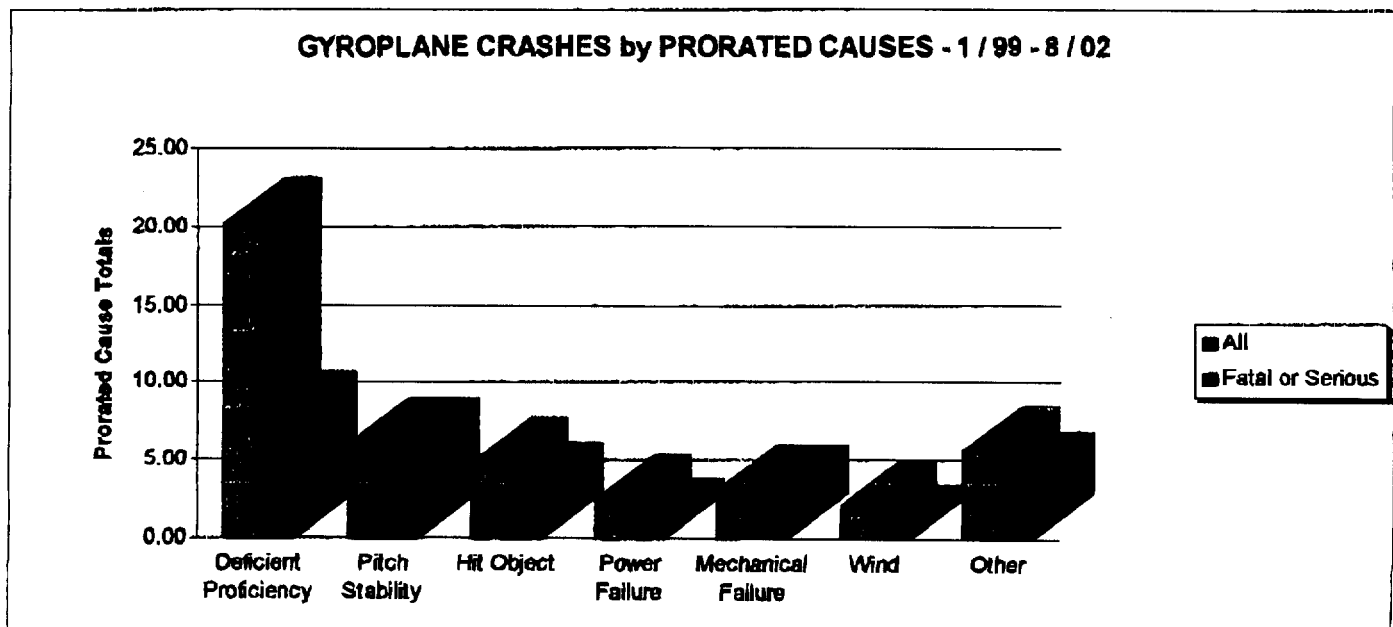
The causes for each crash were proportionally PRORATED as part of a total of 100% cause in each crash record. It should be noted that categorizing crashes by these causes is a subjective matter that could at times be argued. However, the author attempted to apply the interpretation of the cause(s) based on the above definitions. Case numbers as well as the prorated assigned causes are listed in the table of crashes - for reference back to the original NTSB report should there be any questions about these interpretations. It should also be noted that in some cases the assigned prorated cause(s) in this report may differ from the cause(s) identified in the NTSB report based on experience interpreting NTSB reports. As an example, an aircraft had an engine problem and lost power and subsequently hit a tree during the emergency landing. The report may list the cause as failure to maintain clearance from an object, whereas the author believes the "shared" causes included engine failure. Others may consider that pilot proficiency was a "shared" contributor. The author has tried to be consistent in the true root cause(s) of the crash.

Interpretation of Data

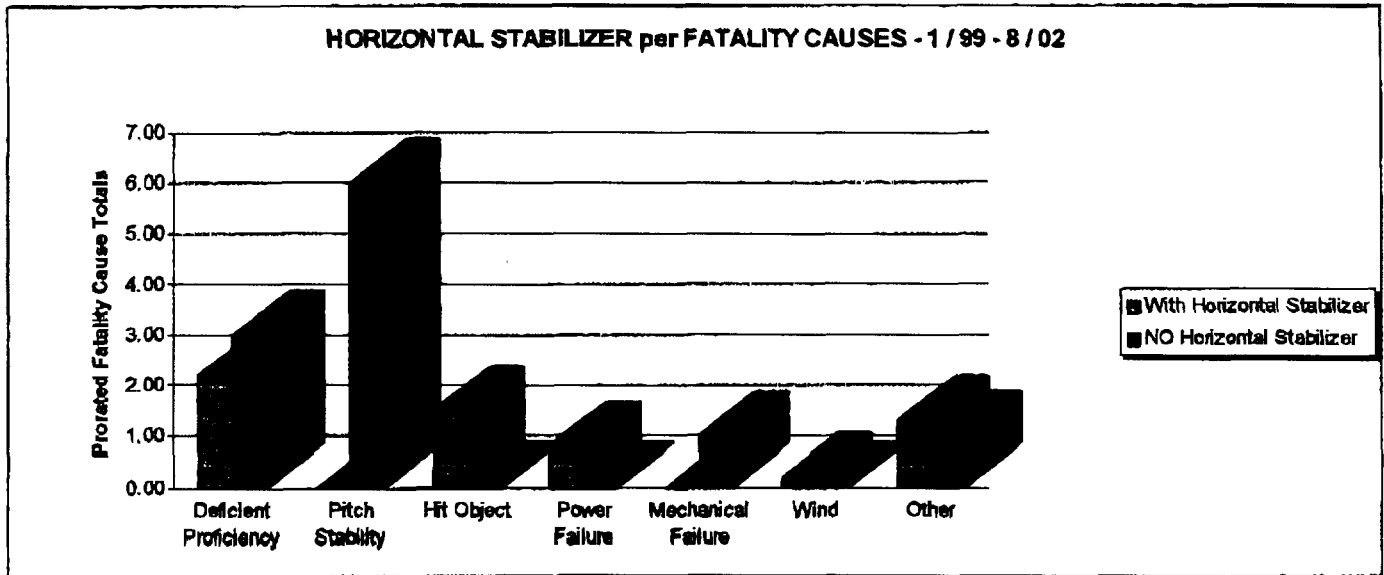
The following table summarizes the PRORATED crash causes for the period under study. Proficiency deficiencies was the largest contributor to crashes as it is indicated as a factor in the majority of crashes. On numerous occasions, pilots had zero time in gyroplanes, yet they attempted to fly them anyway. In other cases, maneuvers were not completed appropriately due to inexperience of the pilot. Flight characteristics of gyroplanes are different from airplanes and helicopters and this continues to become evident as we see pilots with other ratings than gyroplanes, attempt to fly these aircraft.

	All	Fatal or Serious
Deficient Proficiency	20.20	7.80
Pitch Stability	6.00	6.00
Hit Object	4.80	3.10
Power Failure	2.40	0.80
Mechanical Failure	3.00	3.00
Wind	2.00	0.40
Other	5.60	3.90

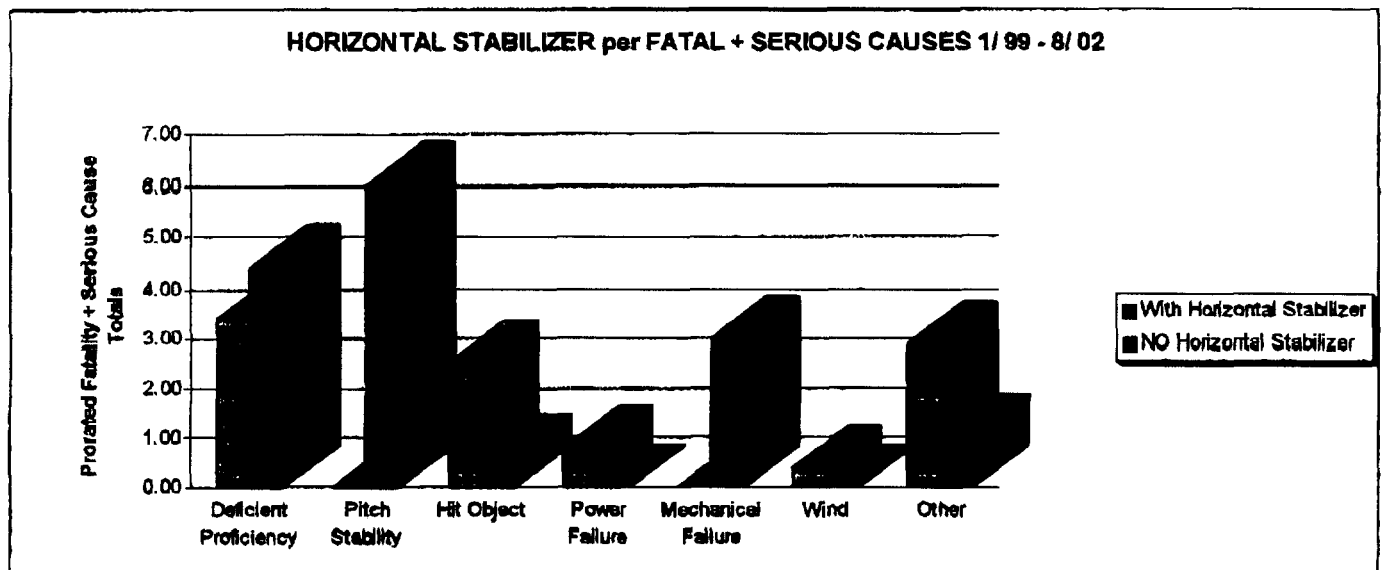
The following chart depicts the above data in a graphical format.



A horizontal stabilizer is a much discussed factor in gyroplane fatalities. The following graph compares the fatality causes according to whether the gyroplane had a horizontal stabilizer or not:



The following graph makes the same comparison for FATAL and SERIOUS injury crashes according to whether the gyroplane had a horizontal stabilizer or not



These graphs perhaps clearly illustrate the areas that might offer the best opportunities to address the current high number of gyroplane fatal crashes. Improvements in pilot training and proficiency, and knowledge of gyroplane aerodynamic and handling issues in order to make good flight judgements are essential to gyroplane safety. Such improved flight judgement based on accepted aerodynamic understanding and appreciation might play an even more important part in preventing gyroplane fatalities.

Universal incorporation of good gyroplane flight handling and stability principles, including appropriately designed horizontal stabilizers, might be the single most productive action that could be taken. Promotion of these basic principles by all major and respected entities within the Sport Gyroplane community would significantly improve acceptance and adherence throughout the gyroplane world. Acceptance of good flight handling principles would encourage more diligent attention to the major issues involved with safe gyroplane operation.

The author will continue to add and further analyze additional gyroplane crash data. As these analyses are completed, this report will be updated and made available.

Date	Case Number	Aircraft	Injury	Deficient Proficiency	Pitch Stability	Hit Object	Power Failure	Mechanical Failure	Wind	Other	Substantial Horiz Slab?	Indicators	Comments
9/12/1999	FTW98FA298	Air Command	Fatal	20%	80%	0%	0%	0%	0%	0%	No		unloaded rotor blades
4/28/2001	LAX01LA161	Barnet	Fatal	40%	0%	0%	30%	0%	0%	30%	Yes		rotor in fuel
7/28/2001	NYC01LA120	Barnet J48	Fatal	40%	0%	0%	0%	0%	0%	80%	Yes		no hang tail performed
4/27/2001	NYC01LA109	Barnes BEM	Fatal	100%	0%	0%	0%	0%	0%	0%	No		failed to maintain control
6/18/2001	LAX01LA078	Demolitor	Fatal	80%	0%	0%	0%	0%	20%	0%	Yes		inadvertent takeoff
3/18/2002	ATL02LA084	GYRO-KOFF-TBR	Fatal	20%	80%	0%	0%	0%	0%	0%	No		high throttle - small HS
1/22/2002	NYD01LA048	Person	Fatal	0%	0%	50%	50%	0%	0%	0%	Yes		power failure - hit trees
3/27/2000	LAX00LA140	RAF 2000	Fatal	50%	50%	0%	0%	0%	0%	0%	No		PIO
4/30/2000	DEB00LA079	RAF 2000	Fatal	30%	70%	0%	0%	0%	0%	0%	No		rotor struck tail
7/28/2000	CH100FAV52	RAF 2000	Fatal	0%	0%	0%	0%	0%	0%	100%	No		flight path over lake Michigan
10/4/2000	CH01LA002	RAF 2000	Fatal	20%	80%	0%	0%	0%	0%	0%	No		rotor struck tail
6/28/2002	ANZ02FA064	RAF 2000	Fatal	20%	80%	0%	0%	0%	0%	0%	No		PIO
7/18/2002	DEB02FA078	RAF 2000	Fatal	20%	80%	0%	0%	0%	0%	0%	No		in-flight breakup
8/30/1998	SEA98LA151	Retortyne 200	Fatal	0%	0%	0%	0%	100%	0%	0%	No		improper torque rotor bolts
10/23/2000	SEA01LA009	Shorbird Adventure	Fatal	20%	80%	0%	0%	0%	0%	0%	No		rotor struck tail
7/24/1999	SEA99LA128A	Sportcopter	Fatal	0%	0%	100%	0%	0%	0%	0%	Yes		may-air collision with Lyrallight
1/26/2002	MA02LA054	Sportcopter	Fatal	80%	0%	0%	0%	0%	0%	20%	Yes		unidentified roll
4/13/2000	MA00LA133	Air & Space 18A	Serious	0%	0%	0%	0%	0%	0%	100%	Yes		unknown - possible pilot error
1/27/1999	NYC99LA053	Air Command	Serious	40%	0%	80%	0%	0%	0%	0%	No		rotor wire
6/28/1999	CH00LA200	Barnes BEM	Serious	0%	0%	0%	0%	100%	0%	0%	No		control failure - corrosion
4/27/2001	FTW01LA114	Barnes BEM	Serious	0%	0%	0%	0%	0%	0%	0%	No		loose control stick
8/21/2000	SEA00LA169	RAF 2000	Serious	0%	0%	0%	0%	0%	0%	100%	Yes		Loss of control - undetermined cause
4/23/2002	FTW02LA110	RAF 2000	Serious	100%	0%	0%	0%	0%	0%	0%	No		unable to maintain altitude - behind power curve
5/20/1999	NYC99LA115	Twinsair	Serious	80%	0%	0%	0%	0%	20%	0%	Yes		rotor flapping
6/19/2002	FTW02LA180	Twinsair	Serious	0%	0%	100%	0%	0%	0%	0%	Yes		hit trees
7/31/2001	NYD01LA188	Air & Space 18A	Minor	0%	0%	0%	0%	0%	0%	100%	Yes		ground clearance
5/28/2002	JAD02LA054	Barnet J48	Minor	100%	0%	0%	0%	0%	0%	0%	Yes		hard landing, rolled over on landing
5/1/1998	CH98LA141	Barnes BEM	Minor	50%	0%	0%	0%	0%	0%	50%	No		
2/20/2000	CH00LA075	Barnes BEM	Minor	80%	0%	0%	0%	0%	20%	0%	No		failed to maintain flying speed - takeoff
4/2/2000	CH02LA104	RAF 2000	Minor	50%	0%	50%	0%	0%	0%	0%	No		hit trees
6/1/2001	CH01LA278	Air Command S32	None	0%	0%	0%	80%	0%	0%	20%	Yes		fuel starvation
8/1/2001	LAX01LA296	Air Command Dual	None	80%	0%	0%	0%	0%	20%	0%	Yes		downward turn - led upward
4/21/2001	MA01LA134	Barnes BEM	None	50%	0%	0%	50%	0%	0%	0%	No		engine malfunction - failed to maintain airspeed
1/16/2000	MA00LA086	Dana M. Moor Dynamite	None	100%	0%	0%	0%	0%	0%	0%	Yes		excessive tail speed
9/29/1999	NYC99LA237	Demolitor	None	100%	0%	0%	0%	0%	0%	0%	Yes		0 speed pedal turn - A/C rapidly lost altitude
12/27/2000	MA01LA047	Grove Eagle	None	50%	0%	50%	0%	0%	0%	0%	No		hit fence on takeoff
2/18/2001	SEA01LA051	Gyrobee	None	100%	0%	0%	0%	0%	0%	0%	No		overhead control stick
10/21/2000	SEA01LA009	Hellet 1	None	0%	0%	70%	30%	0%	0%	0%	No		hit wire on takeoff
4/18/1999	ANX99LA049	RAF 2000	None	30%	0%	0%	0%	0%	70%	0%	No		engine power problem
5/28/2000	ATL00LA057	RAF 2000	None	100%	0%	0%	0%	0%	0%	0%	No		possible downruff
11/18/2000	DEB01LA015	RAF 2000	None	100%	0%	0%	0%	0%	0%	0%	No		directional control on landing
5/3/2001	SEA01LA107	RAF 2000	None	100%	0%	0%	0%	0%	0%	0%	No		student pilot makes flight in new A/C
9/23/2001	NYC01LA230	RAF 2000	None	50%	0%	0%	0%	0%	50%	0%	No		takeoff blade flap
5/6/2002	LAX02LA149	RAF 2000	None	100%	0%	0%	0%	0%	0%	0%	No		failure to maintain control during wind gust
													on takeoff

ADDENDUM 2

GYROPLANE PITCH AERODYNAMIC ISSUES

Author: Greg Gremminger
8/4/2002

Today's 2-blade teetering rotor, tilting spindle light gyroplanes have unique and often misunderstood flight control, maneuverability and stability issues. Light gyroplanes aerodynamic technology was slow to evolve from the original Bensen Gyrocopter of the 1950's and 1960's. Gyroplanes are "floating-wing" aircraft, as opposed to "fixed-wing" aircraft. Many of the misconceptions arise from attempts to apply fixed-wing analogies to gyroplanes. Some fixed-wing analogies can definitely inspire dangerous understandings and perceptions.

For instance, in a fixed wing, the perceived attitude or change in attitude or angle of attack of the wing by the pilot comes from the visual sense of the cockpit pitch attitude - the wing is solidly fixed to the airframe and moves in pitch with the cockpit. In a gyroplane, the cockpit or airframe can float, and its attitude does not necessarily indicate the flight attitude or path of the rotor - which is determinate of the flight path or change of flight path of the aircraft. Therefore, in some gyroplanes, the airframe may "float" or change attitude differently than the actual wing - the rotor disk. For such airframes, those which are not themselves stabilized aerodynamically to track the relative wind, the misleading attitude pitch reactions of the airframe (to a wind gust or g load) may influence the pilot to make commanded control inputs that are inappropriate for the actual flight reaction of the rotor disk.

Especially for the less experienced gyroplane pilot, it is important that the airframe attitude provide an appropriate frame of reference for control inputs. This requires that the airframe track the airstream - much as an arrow tracks straight along its flight path. This requires that the airframe itself be stabilized to always point true to the flight path. The airframe attitude itself has no direct effect on the flight path of the gyroplane - the rotor disk attitude controls the flight path. A gyroplane airframe can be allowed to "float" or swing in any attitude, hanging under the rotor, as long as that float does not impart a destabilizing uncommanded cyclic action into the rotor. In this case, it can be adequate to just leave the cyclic stick float free or loose so as not to impart an uncommanded cyclic action to the rotor.

However, it is not that simple. First, it is difficult for the inexperienced pilot to avoid commanding inputs through the cyclic when the airframe is perceived to pitch nose-up or nose-down. Also, control friction and the offset gimbal trim arrangement on most gyroplanes add coupling to the airframe and to some extent do not allow the cyclic stick to float free. For an unstabilized airframe, one that does not have aerodynamic accommodations to keep the airframe tracking or pointing true to the relative airstream, it is destabilizing to allow the errant pitch rotation of the airframe to couple its movements into the rotor disk through cyclic action of the spindle - the spindle tilts with the airframe if not allowed to float free! For an airframe that responds to wind gusts or g loads in the destabilizing direction, coupling these airframe responses into the rotor imparts the same destabilizing pitch action into the rotor - which then aggravates the initiating condition - positive feedback. The result is a truly unstable aircraft that requires superb pilot skills to react properly and manually stabilize the aircraft system. Compounding this difficulty is the fact that the visual cues of airframe pitching movement can be opposite or out-of-time to the true reaction of the whole aircraft.

What causes the airframe to rotate in pitch in a destabilizing direction? Both a vertical gust of wind or a change in g load can produce a pitching reaction in the airframe. Whether that pitching reaction of the airframe is in the stabilizing or destabilizing direction depends on the configuration of the gyroplane.

A vertical gust of wind can cause the airframe (not necessarily the rotor) to react in pitch according to the flat plate resistance of the airframe seen by the vertical wind gust. If the horizontal flat plate volume aft of the CG is adequate, the airframe will react by pointing INTO the gust of wind - this is the stable direction or reaction of any aircraft. In this, stable-direction case, it is beneficial for the pilot or friction to restrict the cyclic stick movement so the airframe pitch rotation is coupled strongly into the rotor - reducing the effect of the vertical gust by aligning the rotor disk into the change of relative wind. In this case also, the airframe has rotated in pitch so as to indicate to the pilot the actual direction of the wind gust to prompt the proper commanded control input from the pilot if necessary. For such stable-direction airframes, it is normally not necessary to react to the wind gust because the rotor is reacting as a fixed wing would to pitch in the stabilizing direction - the resultant pitching action of the airframe is a much lower, almost imperceptible amplitude because the rotor reaction immediately counteracts the effect of the wind gust.

For an airframe that has more horizontal flat plate volume forward of the CG, the airframe reaction is to point AWAY FROM the wind gust. If this pitch reaction is forced to or allowed to couple into the rotor, a divergent flight path is initiated if not corrected by the pilot. Some amount of all airframe pitch reactions are coupled into the rotor because of the offset gimbal trim spring arrangement. Therefore, the skilled pilot must command compensating cyclic inputs to prevent a divergent reaction of the whole aircraft to that wind gust. At the same time, the pilot visual sense of airframe attitude is confused or amplified by the wrong-direction and excessive

pitch response of the airframe. The less experienced pilots in this situation tend to under control (divergent pitch change allowed) or over-react (pilot induced oscillations - PIO).

G load transient on the machine is a second mechanism that produces a pitching rotation in the airframe. All stable aircraft maintain their lift vector (in this case the Rotor Lift Vector of the gyroplane) aft of the CG during normal flight. With the lift vector aft of the C, a change in lift or g load imparts a pitch rotation in the direction that reduces the g load and stabilizes the aircraft. For a gyroplane that maintains its Rotor Lift Vector (RLV) properly aft of the C, the airframe will rotate in pitch in the stabilizing direction in response to a g load change. This proper direction pitching rotation, if forced or allowed to couple into the rotor, allows the rotor to offset the g load and stabilize the aircraft response to the g load - exactly as a fixed-wing analogy. In the case of a gyroplane with the proper positioning of the CG forward of the RLV, the g load stabilizing effect is enhanced by control friction or pilot restriction of the stick. In most cases for such a gyroplane, commanded control input is not required or excited because the nose-pitching cue to the pilot is essentially non-existent when the aircraft itself is making the proper corrective response.

G load changes on a gyroplane can cause a wrong direction or destabilizing direction rotation of the airframe. This is because, under certain conditions, the free-floating airframe can actually rotate aft so that the CG is aft of the RLV. This can happen from an improper balance of several static pitching moments on the airframe in that particular flight situation. The most common moment that can cause aft positioning of the CG is an unbalanced high propeller thrustline. If the propeller thrustline is above the CG it presents a moment, variable with power setting, that tends to push the nose down and the CG aft. For large high prop thrustline offsets, this moment can be powerful, resulting in CG location on or even well aft of the RLV - a very g load unstable condition. Other particular gyroplane configurations may present moments that orient the CG aft of the RLV - these include a center of drag below the CG or a windscreen or fuselage that imparts a downward force forward of the CG, especially at higher airspeeds.

To regain stability, these destabilizing or nose-down static moments must be balanced by some other moment(s) to prevent the RLV from realigning forward of the CG. The most common gyroplane device to accomplish this balance is a horizontal stabilizer. A properly sized, positioned and oriented horizontal stabilizer can balance the effects of a high offset prop thrustline (reacting in the propwash) and balance the other aerodynamic airframe moments (reacting to the airstream). This is entirely different from the fixed-wing analogy. For a gyroplane in flight, the balance of static thrust and static aerodynamic moments orients the craft. Therefore the location of the CG position relative to the RLV can change in flight according to airspeed and engine power. Often, the CG on some aircraft without a properly balancing horizontal stabilizer may move forward relative to the CG under different extremes or combinations of power and airspeed. This is a significant reason why pitch stability related accidents tend to happen at high power and/or high airspeed conditions.

Compounding the CG location relative to the RLV is the fact that commanded cyclic inputs change the angle of the RLV because the rotor disk attitude itself is changed by cyclic control. An aft stick movement tilts the rotor disk back (increased AOA) and moves the RLV forward relative to the CG position. Under certain conditions, the pilot cyclic action can actually change the g load (maneuvering) stability from stable condition through neutral stability to an unstable condition and back again - just by over-reacting control on the cyclic. Such stability changes excite commanded control inputs and can easily lead to Pilot Induced Oscillations (PIO) by an inexperienced pilot.

So, on a gyroplane, a horizontal stabilizer has TWO beneficial stability effects. First, as described earlier, an appropriate horizontal tail volume imparts a stabilizing pitching rotation to the airframe under vertical wind transients (dynamic stability and damping). Secondly, an adequately designed horizontal stabilizer **STATICALLY** balances the aerodynamic and thrust moments to position the RLV appropriately aft of the CG for g load (maneuvering dynamic) stability.

Typically, gyroplanes with properly designed horizontal stabilizers do not tend to excite PIO - they compensate for vertical wind gusts to prevent divergent reactions and provide proper airframe attitude cues to the pilot as a reference for his/her commanded cyclic inputs. Additionally, such a stabilized airframe enhances stability dramatically when friction or pilot restriction forces airframe pitching rotation to be coupled into the rotor. Once the stabilizing airframe pitch response is coupled into the rotor, the rotor disk stabilizes the flight path by reducing the effects of a vertical wind gust or g load change. Typically the airframe reaction to even very turbulent air in a gyro with a stabilized airframe is meager and steady in small pitch responses - the stabilizing compensating movements of the rotor disk maintain a relatively level airframe and impart only slow vertical motion or sometimes vertical chop to the airframe and aircraft. Such reaction does not excite over-reaction pitch inputs by the pilot because the nose pitch attitude is steady or self-responding to vertical wind transients.

Alternately, gyroplanes with unstable airframes, either from wind gusts or g loads, present a radically pitching airframe, one that does not cue the pilot into proper cyclic reactions. The pilot must learn to ignore the visual cue and present a compensating pitch cyclic commanded input to balance the disturbance. Very proficient pilots of such gyroplanes learn to do this by seat-of-the-pants g load sensation and experience. Inexperienced pilots are subject to possible PIO. Unstabilized airframes and aircraft are subject to possible bunt-over or Power Push-Over (PPO) from the divergent reaction from an extreme down gust. Such divergent nose-down pitch

divergent reactions can rotate a close-coupled (short) gyroplane to inverted in less than a second under certain configurations and circumstances. In such gyroplanes with unstabilized airframes, it is essential that control friction and pilot restriction of the cyclic stick be minimized so as to not impart aggravating rotor reactions.

Some designers suggest alternative pitch dampening devices or configurations. The RAF 2000 gyroplane uses a flexible, rubber mounted mast that, along with certain control link arrangements is claimed to be the equivalent of a horizontal stabilizer. This arrangement proposes that the mast flexes aft under an increased rotor drag transient, imparting a nose-down rotor disk pitch change to reduce and stabilize that drag transient. The effectiveness of this configuration is debated and questioned. Proponents say it is as effective as an actual horizontal stabilizer. Others question the effect and suggest it stops working all together (reaches limit of flexible range) under rotor drag levels presented above 70 mph.

Gyroplane pitch related fatalities generally occur at higher airspeeds and power settings. This is evident on some configurations because the in-flight static moment balance may change and locate the RLV further aft under certain speed/power combinations. Gyroplanes are also much more sensitive or responsive to cyclic inputs at higher airspeeds when the rotor disk Angle of Attack (AOA) is much shallower - nearly horizontal. Minute changes in the rotor disk AOA at such shallow disk AOA provide large changes in lift especially for forward stick movements when the AOA can be easily reduced to zero - zero g! Therefore, if a machine or pilot is prone to over control and PIO, the situation is aggravated at higher airspeeds. At higher airspeeds, with the very shallow rotor disk AOA, it is imperative that the pilot avoid rapid forward cyclic stick movements so as to possibly unload the rotor (zero angle of attack and zero g load on rotor).

Gyroplane PPO can also occur at slow speed when the pilot might subject the aircraft to reduced, zero or negative g loads. This commonly occurs during a push-over at the top of a zoom. Gyroplane training emphatically teaches not to do this, or move the stick rapidly forward under any condition. But, these PPO accidents still happen, and are more prone to happen on high prop thrustline machines that do not have proper balance of the static moments - in this case, at zero load and zero drag on the rotor, a high prop thrustline can start the forward rotation that rapidly accelerates into a PPO. This commonly happens if a pilot overreacts to a sudden uncommanded nose-up pitch movement - the kind that can happen in an unstable airframe. A substantial horizontal stabilizer can slow this uncommanded rotation to allow possible pilot intervention to stop an actual PPO. But, a substantial horizontal stabilizer will probably prevent the initiating uncommanded airframe reaction in the first place.

The autorotating gyroplane rotor slows RPM significantly and rapidly under reduced g loads and transients. At higher airspeeds it is much easier to unload the rotor (low or zero g) and slow it down dramatically by a too rapid forward cyclic input (or a down gust that pitches the nose downward). Once a rotor is slowed too much, when it is subsequently subjected to g loads again, retreating blade stall can occur - this is blade "flap" which is the usual cause for rotor strike on the airframe, tail or propeller. This is the normal result of a PPO, and is commonly reported as an "explosion" in the air, a "tumble", a "backfire", or "pieces flying off". Indications that PPO was the root cause are indications of in-flight rotor strike on the tail or propeller, rudder parts found far from the main wreckage, and inverted impact with the ground.

Unstable gyroplanes present several common pitch stability related fatal accident types. The most common of these are Pilot Induced Oscillations (PIO) and Power Push-Over (PPO) - sometimes referred to as "bunt-over". PIO results from a pilot who is relatively inexperienced in flying a specific unstable gyroplane. A combination of misleading airframe pitching, divergent reactions to wind gusts and/or g loads, short-coupled low moment of inertia airframes, high airspeeds and/or high wind gusts can often lead to pilot over-control and PIO. PIO incidents, if not immediately recognized and stopped by the pilot, typically result in a PPO after 3 or 4 quick pitch (PIO) cycles. Witnesses often report radical up/down pitching immediately before a "loud bang" (rotor hitting something).

PPO is the rapidly accelerating forward pitching as a result of unloading the rotor. If other forward pitching moments are present at the time that the rotor drag decreases toward zero (unloaded rotor), the forward pitch rotation (further unloading the rotor) is unchecked and rotor strikes on aircraft components begin occurring. The rapid forward pitching of the airframe and rotor spindle initiate a rotor precession stall (one blade exceeds inverted stall AOA), and a violent rotor flap occurs which usually contacts other parts of the gyroplane. The unloading of the rotor that initiates a PPO can also, at the same time, cause a rapid slowing of the rotor RPM. Once the rotor is too slow from very low g loading for an extended time, the g load subsequently presented next will cause a retreating blade stall which again results in a very severe blade flap contacting parts of the airframe. In actuality, a combination of all of these disastrous effects probably occur simultaneously as the gyroplane violently pitches forward to inverted - in less than 1 second on short-coupled, low moment of inertia gyroplanes.

Other pitch stability related fatal accidents are described simply as the pilot, sensing a radical nose-down pitching rotation (unstable airframes pitch excessively in turbulent wind), pulls aft on the cyclic, pulling the rotor back and down into the rising tail. This might not be described strictly as a PPO event, but the root causes and the final outcome are the same.

Stabilized airframe gyroplanes present strong protection from these unrecoverable pitch stability related events. Stabilized airframes rotate in pitch very meagerly in response to strong wind and/or g load transients. Any nose pitching from transients is in the proper direction to incline the pilot to react intuitively, properly and less reactively on the controls. The airframe pitch reaction to transients is automatically coupled to the rotor, via friction or pilot restriction on the stick, to reduce the reaction to the transient. The pilot is much less prone to PIO, even at high airspeeds and in gusty conditions. PPO is much less likely also because the airframe and aircraft is resisting any pilot commanded rapid pitch rotation. An adequate horizontal stabilizer also prevents rapid acceleration of a forward pitching rotation. A strong vertical wind gust, even at high airspeeds, is automatically compensated because the airframe and rotor automatically move in the stabilizing direction, as opposed to a divergent direction in unstabilized gyroplanes.

Some common design solutions to these issues are:

- Installation of an adequately effective horizontal stabilizer: Design attention to the volume, positioning (in or out of the prop wash), airfoil shape and incidence angle is crucial. The design objective are a proper balance of the static moments so as to properly maintain the CG positioned well forward of the RLV; and adequate dynamic pitch dampening from a disturbance. For gyroplanes with significantly high propeller thrustlines, the application of the horizontal stabilizer becomes more critical in order to properly balance the strong variable propeller thrustline static moment. Proper application of a horizontal stabilizer should be verified by flight testing. Upon installation of a properly installed horizontal stabilizer, the pilot should be aware that the aircraft might seem to fly or respond differently - the airframe pitch responses to wind gusts and g loads WILL be different, with a stabilized airframe and care must be taken until the pilot becomes accustomed to the new airframe responses.
- Improved propeller thrustline, more closely aligned to the CG of the gyroplane: The larger propellers (to accommodate higher thrust) normally require higher propeller thrustlines to maintain propeller/keel clearance. This is the typical reason that "high thrustline" gyroplanes evolved from the original Bensen Gyrocopter configuration. With a significantly high propeller thrustline, the nose-down static moment is stronger and the horizontal stabilizer required to balance that moment is more design critical. To compensate for larger propellers, some designers choose a "drop keel" frame configuration - the seat and engine are mounted higher and the tail keel and landing gear are extended lower to allow for a lower propeller thrustline more closely aligned with the CG.

Some designs take this "drop keel" concept a step further by positioning the propeller thrustline significantly below the CG. This arrangement provides that the lower propeller thrustline will statically hold the airframe nose higher and the CG further forward when power is applied - a significant improvement in stability under higher power conditions. Tractor configuration gyroplanes sometimes more easily achieve excellent stable airframe requirements because of the long moment arm to the tail and a more readily aligned propeller thrustline.

Sincerely,

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ADDENDUM 3

GYROPLANE TRAINING / INSTRUCTION ISSUES

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Gyroplane pilot proficiency and training issues can be indicated from the NTSB records as significant contributors to gyroplane accidents. Lack of proficiency or poor judgement in operating gyroplanes beyond the pilot or aircraft safe limits are often elements in many accidents. There may be numerous contributors to less than adequate training and knowledge of gyroplanes and gyroplane issues. The gyroplane training infrastructure is certainly less mature than other traditional aircraft type training networks and structures. This is owed to historical and cultural influences within the gyroplane community, to the actual scarcity of gyroplane instructors and check pilots, to the lack of gyroplane knowledge training resources, and even to widely varied and often inadequate understandings and appreciation of gyroplane control and stability issues by both instructors and pilots and the general community. This, coupled with inappropriate reliance on fixed-wing analogies by students and instructors, sometimes leave the less experienced pilots unaware of the limits of that particular gyroplane and the pilot's true capability in that aircraft.

HISTORIC / CULTURAL INFLUENCES

Until the early 1980's when 2-seat trainers began to be available, most gyroplane training was done in gyroplane "kites" towed behind cars or boats. This was an evolution of the original Bensen advertisements to learn to fly gyrocopters yourself - self training. Bensen gyrocopters were touchy aircraft requiring almost a right-of-passage of incidents in the process of learning to fly the gyrocopter. However, these early models were limited in power and speed, and though they had their share of pitch stability related accidents and fatalities, they may not have been as prone to these fatal accidents as the later evolved higher power and speed gyroplanes of the following generations.

The culture from these early gyrocopter pilots was and still often is to dismiss or discourage improvements in both training and flight handling - because, "look how safe it flies" ("for me!"). Add to this that the technical understanding of gyroplane aerodynamics had not really begun to evolve and the evolution of gyroplanes was mostly without good aeronautic engineering development, the accident rates began to rise.

Through the 1980's, 2-seat gyroplane training was becoming available. But, the understanding of the critical aerodynamic issues was slow to evolve or be accepted and is not even today fully accepted. Also, poorly appreciated even today is the fact that there is such a wide variation in gyroplane flight handling and stability characteristics - from truly stable and pilot insensitive, to unstable with limited safe flight envelopes and heavy pilot workload and difficulty in learning or transitioning. Today, 2-seat training is generally accepted and recommended, and a meager network of certified instructors is available, but the past cultural influences still encourage training shortcuts or self-training.

INSTRUCTION SCARCITY:

There are a total of maybe 35 gyroplane instructors throughout the U.S. Many of these are only part-time. The variety of training gyroplanes vary greatly in flight handling and stability characteristics that rarely match the characteristics of the student's single-place small gyroplane. The scarcity of instructors, especially instructors that can provide training in a particular type gyroplane strongly discourages complete training. A common example is the rated fixed-wing pilot that travels several hundred miles to get introductory training, and who later attempts to fly his own gyroplane without instructor endorsement or supervision. The scarcity of both instructors and of flight check Inspectors and Designated Examiners also discourage even starting down the road to complete training for a rating. Pursuing a rating has been further discouraged in the past decade because of the night training and night cross-country requirements - most trainer gyroplanes are not equipped to meet this requirement and instructors are often not willing to endure the risk and difficulty of night cross-country flight in open cockpit experimental aircraft. The result: people are inclined to "get just a few hours of training" before venturing on their own in an aircraft that doesn't even fly like the particular aircraft they trained in!

Initial solo training hours in gyroplanes are much different from the normal fixed-wing process because the student rarely flies the required solo hours under close instructor supervision. Most instructors, because of insurance and liability issues, can not allow students to solo the training aircraft. The student must be "transitioned" into their personal gyroplane - which often has much different handling characteristics - by close radio supervision from the ground. This is a time-consuming process that is only recently becoming widely accepted. Upon first solo flights, the student then often returns to his home, many states away, to complete their solo required flight hours - without close instructor supervision. It is at this point that students often exceed their capabilities and get

into trouble. Risks are exacerbated if the need for transition training into the student's aircraft is unrecognized or minimized - even single-seat gyroplanes may fly much differently than the 2-seat version of the same make.

EXPENSIVE TRAINING:

Gyroplane training is very expensive. Many people get into the gyroplane sport because it is perceived and often advertised as an inexpensive way to fly. This may be true, but the training to get there is not cheap and is often not budgeted. Gyroplane instructors necessarily charge very high hourly rates, because of the equipment investment, the lack of available insurance, the liability risks, and the fact that they must provide a lot of ground training time for gyroplanes - no "canned" ground courses for gyroplanes are available - the instructor must do it all. Add to this the time expense of ground supervised "transition" training into the student's gyroplane, the instructor fees begin to discourage full training. Often the student also incurs significant travel and lodging expenses to seek distant training.

PILOT JUDGEMENT:

Many gyroplane accidents are attributed to poor pilot judgement. It may also be the case that the pilot was not taught or exposed effectively to the prerequisite gyroplane knowledge and principles from which to make good decisions and risk assessments. Gyroplane aerodynamics, flight handling and stability issues are not universally accepted and consistently conveyed to students. Indeed, there is much passionate argument over the actual aerodynamic principles involved. Student and new gyroplane pilots are often presented with inconsistent warnings or dismissal of warnings, and in many cases not even exposed to the pertinent issues. There are few universally accepted textbooks or knowledge references on these issues, not even the segments of the industry can agree on gyroplane stability technology and handling requirements. Good pilot judgement and decision making require teaching consistent and accepted gyroplane aerodynamic principles, and especially exposing the student to the issues that may present limited safe flight envelopes in their particular aircraft.

Many gyroplane "poor judgement" type accidents occur with pilots who are already rated and experienced in other aircraft categories. This can lead to over-confidence and application of inappropriate analogies. But, existing ratings also possibly distract gyroplane instructors from the importance of reviewing the Aviation Decision Making (ADM) elements of the initial rating process. Good exposure to gyroplane specific safety and aerodynamics issues is the essential first step to achieving good judgement. But, even if adequate and appropriate gyroplane knowledge is imparted to the student, perhaps additional instructor time should be spent in review of the ADM principles and hazardous attitudes in light of the new gyroplane issues to be considered. For instance, if limitations are placed in the student's logbook, the student should be fully aware of the implications and reasons why - so that they may have the tools to make good flight decisions.

RECOMMENDATIONS:

Some of the issues and impediments presented above may not be fully correctable until gyroplane instructor availability is much improved and until gyroplane aerodynamic principles are fully accepted and applied. But, I would make the following suggestions:

1. To avoid exacerbating the gyroplane instructor scarcity, gyroplanes should be approved for Special certification under the proposed Light Sport Aircraft (LSA) rules. Without the availability of Special LSA gyroplanes, a significant percentage of gyroplane instructors (current ultralight BFIs) will not be able to continue instructing. This would have a very devastating impact on the accident and fatality rates in sport and experimental gyroplanes, as the availability of instructors would be cut nearly in half!
2. FAA guidance and technical participation in the ASTM gyroplane LSA consensus standard subcommittee is urgent. The subcommittee and its members need credible and professional technical direction toward developing an accepted gyroplane standard. No standard for gyroplanes currently exist, therefore the passionate disagreements on handling and stability principles are likely to continue. FAA technical facilitation and direction may be essential to finally reach a consensus on good gyroplane aerodynamic principles and requirements. Until there is credible and accepted consensus on these aerodynamic principles, student pilots will continue to be deprived of consistent and valid gyroplane knowledge upon which to make good gyroplane flight judgements. The fact that the FAA has not yet declared the availability of Special LSA for gyroplanes, significantly discourages industry participation in even developing a gyroplane standard [suggestion (1) above].
3. The FAA and the Popular Rotorcraft Association (PRA) explore adjustments to the 5209 Exemption - granted to the PRA to allow training-for-hire in experimental gyroplanes. The PRA is considering requesting the following 5209 Exemption changes:

- Required annual review with individual exemption instructors for renewal of exemption. Review should address any gyroplane accidents in the past several years that instructors may be able to address in the instruction they provide.
- Requirement that the exemption instructors provide and apply training lessons for the "transition" of students from the trainer gyroplane into the student's personal aircraft.
- The exemption instructors certify that they are providing training in gyroplane aerodynamic flight handling and stability issues - including the value and purpose of a horizontal stabilizer. This instruction should include training in factors that affect the proficiency limits of that student in that student's specific gyroplane, and address limitations that student's training may present for other gyroplane types - and why.
- The requirement that the exemption instructors limit all endorsements - including transition training for rated pilots - to specific make/model of gyroplanes and any specific limitations on gyroplane flight by that student in that specific make/model gyroplane.
- Requirement that an appropriately effective horizontal stabilizer be installed on all exemption trainer gyroplanes

Sincerely,

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